

that mere juxtaposition with fire as a ceremonial purification may have been in some cases considered equally efficacious with the actual incineration of the bones. The Marquis de Nadaillac has brought together, with admirable clearness and brevity, a mass of negative evidence proving that no distinctive significance can be proved to attach to either of the two great methods of burial; indeed, in places like Hallstadt the confusion seems absolute.

The people who built these mounds must have been a race with very little stone, and almost without copper. Of this metal only a chisel and a few ornaments were found, among the latter being a ring still in its place upon a finger-joint. Their pottery was well represented, though lacking in diversity of type. It was ornamented by cord-marking, by incised and painted designs, and by complicated stamped patterns, some of which give the impression of having been derived from the grain of wooden ware, while others appear to owe their origin to life forms. All the types discovered are copiously illustrated in the plates at the end of the book, and in the woodcuts inserted in the text. The tobacco-pipes discovered differed from those found in Florida, and a mortuary earthenware with a ready-made perforation at the base was non-existent.

Of the other objects found associated with bodies, those made of shell were the most numerous. They included various implements, some possibly agricultural, drinking cups, ornamented gorgets, and large numbers of beads, the latter hardly ever showing traces of contact with fire. Objects of stone and chert were less numerous, but among them may be mentioned celts, hammers, lance and arrow heads, and discoidal stones smaller than those used in the game of *Chungke*, but probably employed in a game of a similar kind. The small pebbles, frequently found in little heaps near human remains, are supposed by Mr. Moore to be the contents of rattles, the turtle-shell covering of which has decayed away. Bone pins were of frequent occurrence; and animals' jaws ground away on the lower part, leaving a flat surface, were discovered in a few instances. Almost everything made of wood had entirely disappeared. What the art in wood of the mound-builders may have been we must conjecture from the discoveries made in the Florida Key dwellings, where the peat has been instrumental in arresting decomposition.

The south-eastern corner of the United States is an area of peculiar ethnographical interest, owing to its proximity to the greater Antilles and to South America: it is fortunate that its exploration has been entrusted to such competent hands, and that the results are published in so admirable a manner.

A JUBILEE VOLUME OF "WIEDEMANN'S ANNALEN."

ON December 11, 1847, Gustav Wiedemann was made Doctor of Philosophy of Berlin University with a thesis "De Novo quodam Corpore ex Urea producto." To celebrate the fiftieth anniversary of that event, the publishers of *Wiedemann's Annalen der Physik und Chemie* conceived the happy idea of printing a jubilee volume composed of special papers by the more regular contributors. The result is a collection of fifty-seven papers by a number of eminent men, including Kohlrausch, Nernst, Ostwald, Quincke, Drude, Warburg, E. Wiedemann, and others of equal distinction.

Four years ago, the golden jubilee of the *Annalen* was celebrated with a retrospect by Hermann von Helmholtz: These annals, with their lineal ancestors, *Poggendorff's* and *Gilbert's Annalen*, cover over a century of German physical science, and are a noble monument to German intellectual activity. No better jubilee gift could have been made to the veteran editor than this collection of choice fruits of his colleagues' labour. We subjoin some extracts which will indicate the nature and value of the work offered, regretting that space does not permit of more.

Reversal of the valve action in discharge tubes, by E. Hagenbach. When the gas in a discharge tube is only slightly exhausted, a conduction current is established at a certain pressure. At higher exhaustions a radiation of electricity sets in, chiefly from the cathode. This radiation takes place more easily from a point cathode than from a surface at the lower pressures, while at higher pressures the reverse is the case.—Torsion and magnetism, by P. Drude. The explanation of the connection between torsion and magnetism must be based upon

the different amounts of internal friction encountered in longitudinal and transverse deformations respectively, giving rise to a peculiar orientation of the magnetic molecules.—The law of Wiedemann and Franz, by F. A. Schulze. This law maintains that the ratio between the thermal and electric conductivities is approximately the same for all metals. The author tested this for iron and steel rods, and found them to exceed the ratio, but not by so much as has been alleged by previous investigators.—Theory of galvanic polarisation, by A. Oberbeck. The determination of the galvanic polarisation in the original circuit is not an impossibility, as has been alleged. It may be closely approached along several lines. The capacity of a cell is a function of the polarisation. It becomes infinite when a certain superior limiting value of the polarising force is reached which produces the maximum polarisation. After that the polarised cell behaves like a constant cell opposed to the main current.—Magnetic after-effect, by I. Klemenčič. Instead of disappearing in strong fields, the magnetic after-effect, or the "viscous magnetic hysteresis," goes on increasing, but its percentage in the total magnetisation becomes less.—An acoustic thermometer for high and low temperatures, by G. Quincke. This thermometer is based upon the interference of a direct and reflected sound-wave of known length, produced by a standard tuning-fork. The wave travels along a tube surrounded by the temperature to be measured. A hearing tube is moved to and fro within the interference tube until a node is reached, indicated by the silence of the hearing tube. The displacement of the latter is read on a divided scale, and immediately indicates the temperature required.—Excitation of stationary waves by electric spark discharges, by F. Melde. An embroiderer's "gold thread" is made to vibrate between the knobs of a battery of jars, somewhat on the principle of the electrostatic cells.—Magnetic susceptibility and atomic magnetism, by G. Jäger and S. Meyer. The authors have found an interesting new relation between the paramagnetic metals. They investigated the magnetic susceptibilities of the chlorides, sulphates, and nitrates of iron, nickel, cobalt, and manganese in aqueous solution at various temperatures. The metal was found to be the decisive element, the acid being without influence. The magnetic susceptibilities per gramme-atom of nickel, cobalt, iron, and manganese were as 2 : 4 : 5 : 6. The gap between 2 and 4 is probably filled up by chromium.—Stratified discharge in the open air, by Max Toepler. The author has succeeded in obtaining a distinctly stratified discharge at atmospheric pressures, which recalls the stratified anode light, by interposing in the path of the spark a semi-conducting plate of dry slate, granite, syenite, or basalt, and ballasting the discharge with a heavy water resistance. Between the bright surface on the kathode and the first stratum a sharp black space is seen, usually very narrow, which is analogous to the black kathode space, and tends to show that there is no fundamental difference between ordinary and vacuum discharges.—Magnetic images, by H. Jaeger. The method of magnetic images may be extended to the case of a constant current traversing a conductor in the neighbourhood of an iron plate. The field created by the current and by the iron plate is the same as if another conductor were placed at the geometrical image of the first conductor in the iron plate, and the latter were removed.—Heating effect of Röntgen rays, by E. Dorn. The author measured the heating effect produced on sheets of platinum or palladium contained in a glass vessel with an aluminium window. The vessel communicated with a Toepler pressure gauge, and the heat was measured by the expansion of the gas. The expansion obtained is much larger than would be accounted for by a dissociation of the gas.—Electroscopic detection of electric waves, by A. Toepler. Describes a modified electroscopic arrangement of great sensitivity. Two upright metallic cylinders stand in a box with walls of glass and ebonite. One of the rods is connected with a rectilinear resonator, the other is put to earth. Any wave incident upon the resonator which produces sparks, sets in violent motion a fine aluminium wire suspended between the two cylinders, which conveys the discharge from one to the other. The aluminium wire is attached to a steel needle, which is just held suspended by its point by a permanent magnet.—Counter electromotive force of aluminium, by V. von Lang. It is well known that in an aluminium-carbon electrolytic cell a current with a voltage under 22 will only pass in the direction carbon-aluminium, and this has been utilised for the electro-chemical rectification of an alternate current. Similarly, in an arc with two aluminium electrodes, a counter E.M.F. of some 19 volts is

developed. An arc with one electrode of aluminium and one of carbon allows the current to pass with greater ease from aluminium to carbon, which is just the reverse of what happens in the cell.—Influence of magnetism on the strength of electric vacuum discharges, by A. Paalzow and F. Neesen. The discharge was produced by a constant high-potential battery. When the lines of force acted across the path of the current, the latter was always enfeebled, and sometimes broken. When they acted along the path, the magnetic field acted like an increase of pressure of the gas, delaying both the setting-in of the discharge and its extinction in the course of exhaustion.—Relation between the positive light and the dark kathode space, by E. Wiedemann. When a positive wire anode is brought into the dark kathode space, the resistance of the intervening gas is not lessened but increased. The positive light bends back until it merges in the negative glow. The same thing happens when the anode is surrounded by a narrow tube. In every case, the discharge traverses the positive strata and the negative glow in succession before it enters the dark space.—Simple demonstration of the Zeemann effect, by W. König. An emission flame which can be placed in a strong magnetic field is viewed through an absorption flame and a dichroscope or a doubly-refracting prism, which gives two images of the emission flame side by side. On making the field one of the images brightens up, owing to the length of its light waves being changed, and therefore no longer absorbed by the absorption flame.—Magnetic and electric wind, by O. Lehmann. Describes some curious cases of the modification of the path of an electric discharge by a magnetic field. An arc between a ring of carbon and a concentric rod of carbon may be made to spin round rapidly, and a comet-like appendage may be made to revolve round the kathode in an "electric egg."

MAN IN RELATION TO THE GLACIAL PERIOD.¹

AS there appears even now to be a doubt in the minds of some as to whether man reached Britain before, during, or after the time known to geologists as the "Glacial period," it might be well on the present occasion to re-examine some of the evidence which has been brought forward to prove the presence of pre-Glacial man, especially from those areas in Britain which are now admitted to contain Glacial deposits, or to have been overspread by ice and snow in the Glacial period.

The most important evidence yet obtained, is that which has been furnished by the ossiferous caverns in the glaciated areas; but the occurrence in the same areas of the remains of extinct mammalia, which are now admitted to have been contemporary with the Cave Man, buried under great thicknesses of Glacial deposits, must also have an important bearing on the question.

All the evidence tends to show that the so-called Tertiary and Quaternary periods merged gradually into each other, and were not separated by any great break in Britain. The higher mountains, before the close of the Tertiary period, must have been covered in part by ice and snow, and the so-called Glacial period can only have a chronological importance as indicating the increased intensity and climax of that cold condition gradually ushered in at the earlier time. For the same reason there is no marked and definite line separating the fauna of the Pliocene from that of the Pleistocene, for we find remains of the animals of the warmer period closely associated with those of the colder in the same deposits and under conditions which show clearly that they lived in those areas at the same time.

North Wales and the North-west of England.

It is generally admitted that during the latter part of the Pliocene period the mountains of North Wales stood at a considerably higher elevation than they do at present; therefore it is but natural to suppose that during that time the streams which flowed from them gradually deepened, widened, and also possibly carved out some of the pre-Glacial valleys. The Carboniferous limestone along the flanks of the mountains, which had at an earlier time been much broken and crushed by earth-movements, now suffered from the additional effects of subaerial action, and wide fissures and caverns were gradually formed in it. In time

¹ "Evidences of the Antiquity of Man furnished by Ossiferous Caverns in Glaciated Districts in Britain." Abstract of Presidential Address to the Geological Society, delivered at the annual meeting, February 18, by Dr. H. Hicks, F.R.S.

some of these, as the streams found outlets at lower levels, would be left comparatively dry, and would then be suitable for habitation by man and beast.

In nearly all those caverns where remains of the extinct animals and the implements of contemporary man have been found, there is some amount of sediment underlying the remains. This must have been left there by the streams or floods which also deposited the material which filled up the narrow descending fissures, thereby making a fairly level floor to the caverns before occupation. This material in every case, unless where there is evidence of its having been subsequently disturbed, consists entirely of such local materials as would be brought down by the streams from the immediately adjoining higher ground. When the higher caverns were first occupied by hyenas it is probable that there was comparatively little ice or snow on the mountains, and many of the animals which lived in the valleys and on the plains extending from them were southern types. Gradually, however, as the cold increased, northern forms appeared on the scene, and a commingling of the two groups took place.

The geographical features in the west and north-west in later Pliocene times may be briefly summarised as presenting high mountainous areas in Wales, Cumberland, the South of Scotland, and in parts of Ireland bordering the Irish Sea and St. George's Channel, with extensive plains traversed by great rivers in the areas now submerged, between the west coast of England and Wales, and Ireland. The conditions here were then in every way suitable to form feeding-grounds for herds of the great mammalia, and indeed such as could never have been repeated afterwards in these areas either in late Glacial or in post-Glacial times.

Animals from the south-east could reach these north-western plains across Cheshire and the lowlands in the centre of England, and others from the south by the plains on the west coast of Wales. In this way northern and southern animals would in a sense freely commingle and be afterwards driven to more southern areas together as the cold increased, and the conditions became more and more unsuitable to them. At first, in the mountains bordering these plains, when only their higher parts were covered with ice and snow, glaciers would occur only in the higher valleys; but as the cold increased they would become confluent with those from adjoining areas, and in time reach the plains and there coalesce to form, perhaps, as has been suggested, one vast sheet reaching across from England to Ireland. Most of the animals, ere the last stage had been reached, would, of course, have disappeared from those parts towards more suitable southern areas.

That the foregoing is, in brief, the history of the incoming of the Glacial period in the north-west is evident from the deposits which have been found in and about the caverns, and in sections at various points on the hills, in the valleys, and around the coast of North Wales.

Wherever the earlier materials have been preserved, especially at high levels, they are seen to consist entirely of local materials, *i.e.* such as would be derived from the immediate neighbourhood, or carried down by streams or ice from the adjoining higher ground.

Over this, and partly mixed up with it in the areas not reached by the northern ice, there is an admixture of materials from other Welsh districts and in the valleys opening out to the north, and along the coast there is the further admixture of erratics from northern areas. It is an interesting fact that the boundary-line in the Vale of Clwyd reached by the northern erratics is very little more inland than the area in which the caverns we have explored occur.

Of the history of the subsequent changes I need say but little; but it seems to me that there is fairly good evidence to show that a considerable subsidence did take place towards the close of the Glacial period, and that this was afterwards followed by a certain amount of upheaval in the same areas.

The presence of such thick deposits of drift, below the level of the sea, at the entrance to the Vale of Clwyd, with bones of the early Pleistocene mammalia at the very base, is a fairly sure test of a stage of subsidence, and it is also difficult to account for the finding of numerous foraminifera in clays at a height of about 200 feet above present sea-level around the coast unless alternating movements of subsidence and upheaval took place. The marine sand with broken shells at high levels, formerly looked upon as sure evidence of subsidence to that depth must not be relied upon too confidently, as in no case has it been clearly shown